09/646929

A method for selectively generating a flow of gas from an open end of a tubular body, such as a hose

The present invention relates to a method for selectively generating a flow of gas from an open end of a tubular body, such as a hose.

A conventional system for producing a flow of pressurised air comprises a compressor, a pressure tank to which pressurised air is delivered from the compressor. The function of the compressor is controlled in dependency of the pressure in the tank so as to maintain the air pressure in the pressure tank substantially at a desired level. Such conventional system comprises air separators and valves which must be able to close tightly.

The present invention provides a method rendering it possible to selectively generate an air flow in a manner which is much more simple than by using conventional pressurised air systems.

Thus, the present invention provides a method for selectively generating a flow of gas from an open first end of a tubular body, said method comprising connecting a second end of the tubular body directly to a gas outlet of a gas compressor, starting the operation of the compressor so as to start the gas flow, and stopping the gas flow by stopping the operation of the compressor. This method does neither require the use of a pressure tank, water separators, nor pressure tight valves. Furthermore, a gas compressor having a relatively small capacity can be used as long as the compressor is able to deliver the desired gas flow.

Therefore, when a gas flow having a predetermined flow rate is desired, the capacity of the gas compressor may be selected so as to obtain the desired gas flow rate through said open free end of the tubular body.

In the method according to the invention generation of the gas flow may be started and stopped by starting and stopping the gas compressor. This means that when the compressor is driven by an electric motor, the operation of the electric motor and thereby generation of the gas flow may be started and stopped by actuating an

electric switch. In order to facilitate operation of the compressor such on/off switch for controlling power supply to the electric motor is advantageously positioned on the tubular body at or adjacent to its open first end.

If the open first end which may, for example, be in the form of a nozzle, is unobstructed the gas flow rate will be substantially constant when the gas compressor is operating. However, the tubular body may comprise a wall part being made from a resilient material. If the open first end of the tubular body is then at least partly closed and subsequently reopened while the compressor is still operating, the resilient wall part will be temporarily expanded, whereby a pressure pulse may be generated. This may be helpful in situations where a short, more powerful gas flow is needed.

The open first end of the tubular body may have a valve or a manually operateable obstructing member which may be moved between positions in which the first end of the tubular body is at least partly obstructed and substantially unobstructed, respectively. In the preferred embodiment, however, the wall part defining or being adjacent to the open first end of the tubular body is made from a resilient material. The open first end of the tubular body may then be at least partly closed by compressing said resilient wall part.

The first open end may be in the form of or may be connected to a nozzle, and liquid, such as water or an aqueous liquid containing one or more additives may then selectively be introduced into the open first end part of the tubular body or into the nozzle. When a liquid flow is introduced while the gas compressor is inoperative a liquid flow may be generated through the open first end of the tubular body. If liquid is introduced into tubular body when the gas compressor is operating an aerosol flow may be generated.

A flow of gas, liquid or aerosol generated by using the method according to the invention may e.g. be used for blow cleaning any kind of articles, such as electronic articles, and a liquid detergent may then be introduced into the tubular body. Alternatively, the liquid being introduced into the tubular body or nozzle may be a disinfectant. The flow of gas, such as air, the flow of liquid, such as water, and the

flow of aerosol, which may be generated by the method according to the invention is especially suited for use by dentists for cleaning the teeth of a patient.

The present invention also provides an apparatus for selectively producing a gas flow, said apparatus comprising a gas compressor having a gas inlet and a gas outlet, an electric motor for driving the gas compressor, means for switching the electric motor on and off, and a tubular body having an open first end part and second opposite end part communicating directly with the gas outlet of the compressor, the capacity of the compressor being such that a desired gas flow through the first open end part is obtained when the gas compressor is operating. The apparatus according to the invention is much more simple and more easy maintain than conventional systems for producing pressurised air

The switching means is preferably positioned on the tubular body at or adjacent to the open first end of the tubular body so that an operator who is gripping said open first end part may conveniently operate the switching means. The tubular body may comprise at least one resilient wall part and manually operateable means, such as valve means or other obstruction means, may then be provided for selectively closing the open end of the tubular body at least partly. At least the first end part of the tubular body may be made from a resilient material so that it may be compressed and thereby at least partly closed.

The apparatus according to the invention may further comprise an outer tube section made from a stiff material and surrounding the free first end part of the tubular body. The manually operateable closing means, such as a pinching device, may then be mounted on this outer tube section. As an example, the switching means may comprise a micro switch embedded in the resilient wall of the free end part of the tubular body. The switching means may then automatically be actuated when the manually operateable means are operated in order to at least partly compress and close the open first end part of the tubular body.

The apparatus according to the invention may further comprise a liquid delivery tube opening into the free end part of the tubular body, and means for selectively delivering liquid into the free end part of the tubular body via the delivery tube. These liquid

delivery means may comprise a liquid pump and an electric motor for driving the pump and the operation of the electric motor driving the pump may be controlled by switch means which are arranged at or adjacent to the first end part of the tubular body. The said first end part of the tubular body or hose, or said outer tube section may be in the form of a nozzle, or the tubular member or hose may be connected to such nozzle. An operator holding the nozzle in his hand may then conveniently control the function of not only the gas compressor, but also of the liquid pump.

The open end of the liquid delivery tube is preferably directed towards the open end of the tubular body so that a liquid jet leaving the liquid delivery tube may pass further through the open end of the tubular body which may, for example, be in the form of a hose of a resilient material.

Ins. by

The invention will now be further described with reference to the drawings, wherein

Fig. 1 is a diagrammatic side view of an embodiment of the apparatus according to the invention.

Fig. 2 is a side view in an enlarged scale of a nozzle formed at the free end of a hose forming part of the apparatus shown in Fig. 1,

Fig. 3 is an end view of the nozzle shown in Fig. 2,

Figs. 4 and 5 are sectional views illustrating the function of a manually operateable switching and valve device, and

Fig. 6 is a perspective view of a coupling device.

Ins. b7

The drawings illustrate an apparatus or unit for selectively generating a flow of air or gas, a flow of water or another liquid, or both. Such apparatus is suited for use by dentists for cleaning and treating the teeth of a patient.

b8

The apparatus shown in Fig. 1 comprises a piston compressor 10 comprising a suitable number of cylinders. In the present case four cylinders are arranged on either side of a common crank shaft. The shaft of a brushless DC electric motor 11 is connected to the crank shaft, e.g. by means of a coupling device as that described in a Danish patent application (filed at the same time as the present application, our ref. 21121DK1). The manifold tubes 12 of the compressor are connected to a hose 13 having a nozzle 14 formed at its free end. A liquid pump 15 is driven by an electric

motor 16 which may correspond to the electric motor 11, and the outlet of the pump 15 is connected to a tube 17 having a free end opening into the free end or nozzle of the hose 13, vide Fig. 2.

The free end of the hose 13 is received in a nozzle tube 18 which may be made from a relatively stiff material, such as metal or plastic, while the hose 13 is preferably made from a resilient, elastic material, such as rubber, silicone or a soft plastic material. The free ends of the hose 13 and of the tube 17 open into the nozzle tube at the free end of the nozzle and as illustrated in Fig. 2. A flexible valve arm or switching arm is mounted on the outer surface of the nozzle tube 18. An obstruction member 20 extends inwardly from the free end of the arm 19 and is positioned oppositely to a cut-out or opening 21 formed in the nozzle tube 18. The free end of the arm 19 also carries a pair of electric switches 22 and 23 for controlling the function of the electric motors 11 and 16, respectively.

When the switch 22 is depressed the electric motor 11 is started so that a flow of air or gas through the hose 13 and out from the opening of the nozzle 14 is generated. The air flow may be stopped by the depressing the switch 22 once again so as to stop the electric motor 11 and the compressor 10. Similarly, a flow of water or another liquid may be generated by depressing the switch 23 whereby the electric motor 16 is started. It is also possible to depress the switches 22 and 23 at the same time so as to generate a flow of air and water or another liquid. The rate and force of the flows generated correspond to the capacity of the compressor 10 and the liquid pump 15, respectively.

However, in some situations the operator or dentist may want to generate a more forceful flow pulse. This may be obtained by applying an increased force to the switch 22 and/or 23 so as to flex the arm 19 inwardly, whereby the obstruction member is passed through the opening or cut-out 21 and locally pinches the hose 13 as best illustrated in Fig. 4 and 5. When the hose 13 is pinched as illustrated in Fig. 5 and a compressor 10 and/or the pump 15 continue(s) to operate the hose section being upstream of the obstruction member 20 will be elastically expanded. When the operator shortly after releases the switches 22 and/or 23 the arm 19 and the obstruction member 20 return to the starting position shown in Fig. 4. Now the

elastically expanded tube 17 return to its normal position whereby a pressure pulse is generated in the flow of air and/or liquid.

Fig. 6 shows a coupling device 25 for transmission of torque between a pair of substantially aligned shaft ends 26 and 27. The coupling device is in the form of a tubular member made by a helically wound wire, which may, for example, be made of metal or plastic. The opposite end parts of the wound tubular member 25 snugly receive the adjacent shaft ends 26 and 27 therein so that the friction between the outer peripheral surfaces of the shafts and the inner surface of the tubular coupling device may be sufficient to transmit the necessary torque between the shafts 26 and 27. However, in order to increase the torque which may be transmitted, a free wire end 28 at one or at each end of the tubular coupling device 25 may be received in a slot 29 or another recess formed in the shaft 27.

The coupling device according to the invention induces a certain flexibility in the torque transmission. Furthermore, the coupling device 25 may be used also when the shaft ends 26 and 27 are not in complete alignment. This means that the coupling device may be inserted between shaft sections in order to allow increased tolerances. Thus, the crankshaft of the small scale piston compressor 10 may be divided into lengths or sections which are interconnected by flexible coupling devices 25.

The apparatus shown in Fig. 1 may be formed as a hand held unit and may replace much more bulky and space consuming conventional pressurized air systems. The apparatus according to the invention may be made portable or may be built into a unit also containing other kinds of dentist tools and apparatuses.

Fig. 6